

**CASL Industry Council Meeting
4 – 5 November 2015
Meeting Minutes**

The autumn 2015 meeting of the Industry Council (IC) for the Consortium for Advanced Simulation of Light Water Reactors (CASL) was held on 4 – 5 November 2015 at the Oak Ridge National Laboratory (ORNL) in Oak Ridge, TN. The first day of meeting was a joint meeting of the CASL Industry and Science Councils and was held at the Spallation Neutron Source (SNS) facility at ORNL. An independent IC meeting was held the morning of the second day and was led by the CASL Industry Council Chairman Scott Thomas of Duke Energy. In the afternoon of the second day the Industry and Science Councils rejoined for a common out-brief meeting.

The IC meeting attendees and their affiliations are listed on Attachment 1 to these minutes. Attendance was by invitation only. Representatives from 14 organizations were invited of which 11 people attended representing 11 organizations. Ten members of the CASL project team participated in the IC portion of the meeting.

The meeting followed the agenda included as Attachment 2 to these minutes.

On the first day, the following technical presentations were made by CASL staff to the joint Industry and Science Council participants.

- CASL Director Jess Gehin (ORNL) and CASL Chief Scientist Paul Turinsky (NC State) provided an overview of CASL's 2015 accomplishments.
- PHI Deputy Lead Scott Palmtag (Core Physics) discussed the status of VERA-CS including its performance and validation.
- Ralph Smith (NC State) presented a “deep dive” focus on uncertainty quantification and data assimilation efforts being conducted in the VMA Focus Area.
- Over lunch, Sarah Edge (NC State) described the status of the market research being conducted in the TDO Focus Area to support structuring the post-CASL entity.
- THM Lead Emilio Baglietto discussed CASL thermal hydraulics modeling with an emphasis on CFD modeling efforts and the path-forward.
- Zeses Karoutas (Westinghouse) led an extended discussion on the status of and plans for each of the CASL Challenge Problems (CRUD including CIPS and CILC, GTRF, PCI, DNB, RIA, LOCA). In these discussions the various Challenge Problem Integrators led the discussions for their respective Challenge Problems.
- Finally, DoE Project Manager Alex Larzelere provided his views on the “light federal touch” that has been applied to CASL since its inception and its implications for CASL Phase 2 and potentially other DOE R&D Programs.

On the second day, the IC met separately from the SC in the morning. After introductions of each of the IC participants, Scott Thomas (Duke Energy) provided an industry perspective of the IC's role in CASL. Scott indicated that the objective of this IC meeting was to obtain a good understanding of where CASL is and where it plans to go in terms of both technical capabilities

and deployment to industry and other external stakeholders. The following presentations were made to the IC by CASL staff.

- TDO Deputy Lead Rose Montgomery (TVA) provided a summary of the TDO workshop that was conducted at ORNL on Monday and Tuesday 2 – 3 November.
- Fausto Franceschini (Westinghouse) provided a detailed discussion of application of VERA to the AP-1000 reactors.
- A significant portion of the morning was devoted to discussion of CASL Test Stands. First, Bill Bird (TVA) provided an overview of the TVA Test Stand modeling the Lower Plenum Flow Anomaly (LPFA) issue. Next, Chris Lewis (AREVA) provided a status of the AREVA Test Stand that is planned to be conducted in 2016. Finally, CASL Test Stand Coordinator Steve Hess (EPRI) led a discussion of the status of Test Stands that have been conducted and the TDO plans for Test Stands during Phase 2.
- During lunch Rose Montgomery led a discussion of plans and a proposed schedule for forming the VERA Working Group.
- Finally, at the end of the session Dan Ingersoll (NuScale) provided a presentation on the development of the NuScale iPWR SMR and possible applications of VERA (including the potential for deployment of a Test Stand application during CASL Phase 2).

Note that all of the presentations (from both days of the meeting) are available to the IC members at the IC portion of the [casl.gov](http://www.casl.gov) website – direct link:

<http://www.casl.gov/docs/Consolidated-IC-Slides-November-2015.pdf>

(Because the presentation slides contain the technical details discussed and are available to IC members, these details are not repeated in these minutes. Results of IC member thoughts and recommendations provided in the IC Roundtable are presented below.)

At the conclusion of the meeting the Industry and Science Councils rejoined at the SNS complex at ORNL. At this time the IC conducted a roundtable discussion in which its members provided their perspectives on CASL capabilities and deployment plans. The following provides a summary of these perspectives.

Eric Volpenhein (CD-Adapco, Inc.)

- Does not see CD-Adapco being a user of VERA (is not a core competency) but does see a desire for them to participate in the proposed VERA Working Group (WG) to remain in touch with the nuclear energy user community and support their needs.
- Believes CASL has made “amazing progress” with a clearer understanding of how computational fluid dynamics (CFD) can provide a valuable contribution to addressing the issues faced by the community.
- Previous to this meeting, he was concerned that use of VERA would require use of “big” high performance computation (HPC) capability – thus potentially limiting the degree to which it would be adopted by industry. As a result of the discussions at the IC / SC meetings, he indicated that he is now very encouraged by the recent successes in use of VERA on industry class cluster computing capabilities.

Ian Stevenson (Simulia)

- Indicated agreement with comments provided by Eric.

- Believes CASL is successfully overcoming the challenges that are typical of large / dispersed software development.

Jim Banfield (Global Nuclear Fuels)

- It is obvious that CASL has much more development to do to be able to undertake BWR applications.
- Indicated GNF would like VERA to become a tool to improve fuel cycle economics and that this represents a requirement for GNF to be willing to participate and invest in the adoption of the technology.

Dan Ingersoll (NuScale)

- Pleased to see how VERA has matured and CASL has remained on track to deliver advanced capabilities.
- However, there is still a large number of technical gaps that need to be addressed. There also is a large number of “knobs needed” to generate useful results.
- Although significant progress has been made, the concern remains that a large amount of computational resources is required to run realistic problems using VERA and CASL developed technology.
- Recommended that CASL leadership remain focused on technology deployment, management, and training to achieve the objective of building a large end user base.

Kathleen Parrish (Arizona Public Service)

- Kathleen indicated that, from the perspective of a NPP owner / operator, the primary emphasis for CASL during phase 2 needs to be on providing value to the broad nuclear power community. She indicated that she was not sure VERA could provide sufficient value to become a self-sustaining product if it could not be used in licensing applications.
- From Kathleen’s perspective, two key licensing applications that should be pursued are capabilities to support load following and NPP power uprates.

Chris Lewis (AREVA-NP)

- Believes that at this point in time VERA has developed to a point where it can be applied to real problems.
- However, based on AREVA’s work using VERA to determine an appropriate Test Stand application, the timeframe needed to obtain results using typical industry class HPC capabilities is still far too long for industry use in many applications. This represents a significant hurdle to widespread adoption by industry.
- Chris believes there are two possible strategies to demonstrate VERA value to industry and enable successful deployment. (1) Focus on speedup of VERA performance so it can be applied to a wide range of applications. (2) Concentrate development on a select set of applications that have high value to industry.

Robin Jones (Southern Nuclear)

- Robin indicated that he is concerned that the organization / bureaucracy created within CASL could become an impediment to successful transition to the post-CASL entity and related VERA Users Group.
- Does see the significant potential for CASL-developed tools to be applied to address the issue of CRUD, thus providing significant value to industry. He also believes VERA may eventually be able to provide value in select safety-related applications.

Simon de Haas (Rolls Royce)

- Indicated that CASL has achieved a well-integrated and flexible program and he suggests that CASL leadership remain focused on maintaining that attribute.
- Believes that the practical integration of the diverse physics and computational codes is a positive aspect of CASL.
- Recommends that CASL consider collaboration with similar R&D efforts occurring in the United Kingdom – particularly in the area of thermal-hydraulics.

Dudley Raine (BWXT)

- Sees the high fidelity of the VERA codes and the built-in feedback capabilities as a great asset.
- Provided recognition that there is still a great deal of validation work that needs to be performed before CASL tools will truly be useful and accepted by industry. He indicated that demonstration of the code in any regulatory application will be a significant challenge.

Zeses Karoutas (Westinghouse)

- Indicated that Westinghouse is very optimistic that, in the end, the CASL-developed tools will prove to be useful. However, to achieve widespread adoption by industry, the “workhorse” portion of VERA will need to be compatible for use on industry class HPC machines ~1000 cores and that delivering this capability should be a primary CASL focus.

Brad Black (Duke Energy)

- Indicated that the work accomplished so far by CASL is “very impressive” and that the core simulator work is expected to be useful to industry.
- To achieve widespread adoption by industry, CASL needs to differentiate where VERA provides improvements over the current generation of codes and standard industry methods and practices (i.e. define the value proposition for VERA).
- To achieve successful deployment during phase 2, CASL needs to resolve the long-term ownership plan (i.e. what the post-CASL entity will be and how it will function).

Scott Thomas (Duke Energy)

- Scott first thanked all of the CASL staff for the quality of the presentations that resulted in a successful Industry Council meeting.
- He indicated that the work accomplished to date has been very useful. He indicated that demonstration of depletion capability in VERA-CS is a significant accomplishment. He also is encouraged that CASL is beginning to widen its deployment with particular emphasis on start-up of the AREVA Test Stand.
- Reiterated the comment that CASL needs to address the issues associated with licensing of the VERA code and that this needs to be addressed expeditiously to support successful adoption by industry users.
- Based on the technical presentations, Scott indicated that CASL needs to refocus efforts on BISON and MAMBA as he believes this work is now the critical path and is needed to bring these codes to a level of maturity comparable to that contained in VERA-CS.
- Finally, Scott indicated he will return to Duke and work to resolve the “log jam” of providing access to Duke operational data to support validation efforts.

The following Action items were identified as a result of this meeting:

Action Items:

1. In the future, the IC requested that presentation slides be developed and provided to council members prior to the meeting. | Owner: Dennis Hussey | Due: 2 weeks prior to spring 2016 meeting.
2. Provide IC access to VERA training materials for review and comment on applicability to industry needs. | Owner: Rose Montgomery | Due: TBD. (Note – need EC check prior to making available to non-US IC members,)

At the close of the reconvened joint IC / SC session, Richard Lahey provided a briefing of Science Council findings and recommendations to the CASL Team.

FMC

- The BISON code is now in pretty good shape and is getting close to being ready for V&V activities.
- Recommend that CASL conduct some “deep dives” into MAMBA to improve the physical models. The SC does not believe MAMBA is ready for V&V at this time.

THM

- The SC believes that the multiphase CFD modeling is now on track with work underway to develop applicable closure models for PWR applications,
- A lot of work is still needed in flow regimes other than subcooled boiling (to support PWR transient analysis capability and all modes of BWR analysis). The SC believes that application of VERA to BWRs (from a T-H perspective) during Phase 2 may be an overreach.
- The SC believes CTF has been demonstrated to be accurate for single phase and low quality boiling regimes. However, it will not be sufficiently accurate for other flow

regimes as encountered in BWRs and may inhibit usage of VERA for BWR applications. This needs to be addressed, likely requiring substantial more work on CTF.

RTM

- Concluded that, except for transient capability, VERA neutronics capabilities “look really good”. In the case of transient / safety challenge problems, the SC is concerned with the level of computational resources that will be needed to perform a full core RIA analysis.

VMA

- The SC has concluded that CASL V&V has “turned the corner” and that VUQ has adopted a realistic and achievable approach.

Overall, the Science Council indicated they were impressed with the work accomplished by CASL to date. They also believe the funding allocations made to the different science based focus areas are appropriate.

The next in-person meeting is scheduled for the March – April timeframe in 2016 at a location to be determined. Additionally a webcast will be planned for the January – February timeframe.

The meeting was adjourned at approximately 3:00 PM on 5 November.

Prepared: 11 November 2015

Distributed to Industry Council: 1 April 2016

Prepared By: Stephen M. Hess (CASL Test Stand Coordinator)

Attachment 1: Industry Council Meeting Attendees

Industry Council Members

1. Chris Lewis – AREVA (Christopher.Lewis@areva.com)
2. Scott Thomas – Duke Energy (Scott.Thomas@duke-energy.com)
3. Brad Black – Duke Energy (bradley.black@duke-energy.com)
4. Jim Banfield – Global Nuclear Fuels (james.banfield@ge.com)
5. Daniel Ingersoll – NuScale Power (dingersoll@nuscalepower.com)
6. Simon de Haas – Rolls Royce (Simon.de.Haas@Rolls-Royce.com)
7. Ian Stevenson – Simulia (Ian.Stevenson@3ds.com)
8. Eric Volpenhein – CD-Adapco (eric.volpenhein@cd-adapco.com)
9. Robin Jones – Southern Nuclear (rdjones@southernco.com)
10. Kathleen Parish – Arizona Public Service (Kathleen.Parish@aps.com)
11. Dudley Raine – BWXT (daraine@bwxt.com)
12. Zeses Karoutas – Westinghouse (karoutze@westinghouse.com)

Science Council Members (participation in joint sessions only)

1. Phillip Finck – INL (phillip.finck@inl.gov)
2. Richard Lahey – RPI (retired) (laheyr@rpi.edu)
3. Elmer Lewis – Northwestern (retired) (e-lewis@northwestern.edu)
4. Kord Smith – MIT (via Vido presence) (kord@mit.edu)
5. Finis Southworth – AREVA (retired) (finis3@comcast.net)
6. James Tulenko – Florida (retired) (tulenko@ufl.edu)
7. William Weber – Tennessee / ORNL (wjweber@utk.edu)

Note – William Oberkamp (Sandia (retired) – wloconsulting@gmail.com) had to return home and was not able to participate in the meeting.

CASL Staff

1. Jess Gehin – ORNL (gehunj@ornl.gov) (participation in joint sessions only)
2. Doug Burns – INL (douglas.burns@inl.gov)
3. Paul Turinsky – NCSU (ncsu.edu) (participation in joint sessions only)
4. Rose Montgomery – TVA (montgomery@tva.gov)
5. Jeff Banta – ORNL (bantajp@ornl.gov)
6. Matt Sieger – ORNL (siegermt@ornl.gov)
7. Scott Palmtag – Core Physics (palmtagsp@ornl.gov)
8. Faust Franceschini – Westinghouse (francef@westinghouse.com)
9. Nathan Capps – University of Tennessee (ncapps@utk.edu)
10. Kevin Clarno – ORNL (clarnokt@ornl.gov)
11. Andrew Godfrey – ORNL (godfreyat@ornl.gov)
12. Sarah Edge – NCSU (sarah.edge@ashleighfisher.com)
13. Ralph Smith – NCSU (rsmith@ncsu.edu)
14. Joe Radhid – Anatach (Joe.Rashid@anatach.com)
15. Gregg Swindlehurst – GS Nuclear (gsnuclear@bellsouth.net)

Attachment 2: Industry Council Agenda

Wednesday, November 4

Joint Industry and Science Council Meeting (SNS-Building 8600, Room C156)

8:00	Check In (Building 5200, Visitor's Center)	
8:30	CASL technical accomplishments past 12 months	Jess Gehin Paul Turinsky
9:45	<i>Break</i>	
10:00	VERA-CS: Performance and Validation	Scott Palmtag
11:00	Spotlight on VMA Focus Area: UQ & Data Assimilation Activities	Ralph Smith
12:00	Working Lunch – Status of Market Assessment and Post-CASL Organization Planning	Sarah Edge
1:00	Spotlight on Thermal Hydraulic Focus Area: CFD Progress & Path Forward	Emilio Baglietto
2:00	Status of Challenge Problems – Progress Made: Overview GTRF & CRUD	Zeses Karoutas Brian Wirth Jeff Secker
3:00	<i>Break</i>	
3:15	Status of Challenge Problems – Progress Made: PCI, DNB & LOCA/RIA	Joe Radshid Yixing Sung Gregg Swindlehurst
4:15	BWR Simulation Progress: CTF and MPACT	Robert Salko Scott Palmtag
4:45	CASL Phase 2 Light Federal Touch	Alex Larzelere
5:00	Adjourn	

Thursday, November 5**Industry Council Meeting (SNS-Building 8600, Room C156)**

8:30	Welcome and Introductions	Scott Thomas
9:00	Update on Application of VERA to AP-1000	Fausto Franceschini
9:40	Test Stands - AREVA Test Stand - TVA Test Stand	Steve Hess Chris Lewis Rose Montgomery
10:45	<i>Break</i>	
11:00	VERA User Group	Rose Montgomery
11:45	Working Lunch – VERA Licensing and Release Process	Matt Sieger
12:45	SMR Vendor Plans and Perspectives	Dan Ingersoll
1:15	Open Comments for IC Meeting	Steve Hess
1:30	<i>Break</i>	

Science Council Meeting (Building 5700, VOCC Complex)

7:45	Bus to Building 5700 – Meet in SNS-Building 8600 Lobby	
8:00	Update on FY15 Performance and FY16 Plans	Jess Gehin / Paul Turinsky
8:30	Progress and Planning for Codes & Challenge Problems V&V	Vince Mousseau
9:00	50/30/20 Funding Split: SC Recommendation versus Actual	Paul Turinsky
9:30	Charge to Science Council Regarding S&T Annual Review	Bill Oberkampf (Chair)
9:50	Break and Relocation to Breakout Meetings	
10:10	Breakout Meetings with Focus Area Leads: Response to Science Council Recommendations	Science Council and FA Leads
12:00	Science Council Working Meeting on A&T Annual Review Preparation, working lunch, Building 5700 / Rm. G305	Science Council
1:30	Bus back to SNS-Building 8600	

Joint Industry Council / Science Council Meeting (SNS-Building 8600, Room C156)

1:45	<i>Science Council Joins Industry Council</i> Industry Council Round Robin	All Industry Council
2:45	Industry Council Action Items	Steve Hess
3:00	Science Council Out Briefing of Major Findings	Bill Oberkampf (Chair)
4:00	Adjourn	